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PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference 27845-10	**FOR FURTHER ACTION**	See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)
International application No. PCT/US 03/25234	International filing date *(day/month/year)* 13.08.2003	Priority date *(day/month/year)* 14.08.2002
International Patent Classification (IPC) or both national classification and IPC G01T1/00		
Applicant JP LABORATORIES et al.		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 14 sheets, including this cover sheet.

   ☒ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

   These annexes consist of a total of 6 sheets.

3. This report contains indications relating to the following items:

   - I ☒ Basis of the opinion
   - II ☐ Priority
   - III ☒ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
   - IV ☒ Lack of unity of invention
   - V ☒ Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
   - VI ☐ Certain documents cited
   - VII ☐ Certain defects in the international application
   - VIII ☐ Certain observations on the international application

Date of submission of the demand	Date of completion of this report
09.03.2004	16.11.2004
Name and mailing address of the international preliminary examining authority: European Patent Office - P.B. 5818 Patentlaan 2 NL-2280 HV Rijswijk - Pays Bas Tel. +31 70 340 - 2040 Tx: 31 651 epo nl Fax: +31 70 340 - 3016	Authorized Officer Lehnert, A Telephone No. +31 70 340-4234

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/US 03/25234

I. Basis of the report

1. With regard to the **elements** of the international application *(Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17))*:

Description, Pages

1-45 as originally filed

Claims, Numbers

1-66 received on 15.07.2004 with letter of 09.07.2004

Drawings, Sheets

1/5-5/5 as originally filed

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

   These elements were available or furnished to this Authority in the following language: , which is:

   ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).

   ☐ the language of publication of the international application (under Rule 48.3(b)).

   ☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

   ☐ contained in the international application in written form.

   ☐ filed together with the international application in computer readable form.

   ☐ furnished subsequently to this Authority in written form.

   ☐ furnished subsequently to this Authority in computer readable form.

   ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.

   ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

   ☐ the description, pages:

   ☐ the claims, Nos.:

   ☐ the drawings, sheets:

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)).

   (Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)

6. Additional observations, if necessary:

III. Non-establishment of opinion with regard to novelty, inventive step and industrial applicability

1. The questions whether the claimed invention appears to be novel, to involve an inventive step (to be non-obvious), or to be industrially applicable have not been examined in respect of:

   ☐ the entire international application,

   ☒ claims Nos. 20,28-30,32,42,44-46,55-61,63-66

   because:

   ☐ the said international application, or the said claims Nos. relate to the following subject matter which does not require an international preliminary examination (specify):

   ☐ the description, claims or drawings *(indicate particular elements below)* or said claims Nos. are so unclear that no meaningful opinion could be formed *(specify)*:

   ☐ the claims, or said claims Nos. are so inadequately supported by the description that no meaningful opinion could be formed.

   ☒ no international search report has been established for the said claims Nos. 20,28-30,32,42,44-46,55-61,63-66

2. A meaningful international preliminary examination cannot be carried out due to the failure of the nucleotide and/or amino acid sequence listing to comply with the standard provided for in Annex C of the Administrative Instructions:

   ☐ the written form has not been furnished or does not comply with the Standard.

   ☐ the computer readable form has not been furnished or does not comply with the Standard.

IV. Lack of unity of invention

1. In response to the invitation to restrict or pay additional fees, the applicant has:

   ☐ restricted the claims.

   ☐ paid additional fees.

   ☐ paid additional fees under protest.

   ☐ neither restricted nor paid additional fees.

2. ☒ This Authority found that the requirement of unity of invention is not complied with and chose, according to Rule 68.1, not to invite the applicant to restrict or pay additional fees.

3. This Authority considers that the requirement of unity of invention in accordance with Rules 13.1, 13.2 and 13.3 is

☐ complied with.

☒ not complied with for the following reasons:

see separate sheet

4. Consequently, the following parts of the international application were the subject of international preliminary examination in establishing this report:

☐ all parts.

☒ the parts relating to claims Nos. 1 (part) - 5 (part), 6, 7, 8, 11, 12 (part) - 19 (part), 21 (part) - 27 (part), 31 (part), 33 (part) - 41 (part), 43 (part) .

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes:	Claims	11, 13-16
	No:	Claims	1-8,12,17-19,21-27,31,33,34,35-40,43
Inventive step (IS)	Yes:	Claims	11
	No:	Claims	1-8,12-19,21-27,31,33,34,35-40,43
Industrial applicability (IA)	Yes:	Claims	
	No:	Claims	1-8,11-19,21-27,31,33,34,35-40,43

2. Citations and explanations

see separate sheet

Re Item III

The following claims as originally filed have not been searched:
20, 28-30, 32, 42, 44-46, 53(part), 55-61, 63-66

Reason for obscurity:
The following claims are unclear to such an extent contrary to the requirements of Article 6 PCT that a meaningful search for these claims cannot be carried out: Claim 20 refers back to claim 20, thus making a meaningful search impossible. Claim 28 refers back to claim 28, thus making a meaningful search impossible. Claims 29 and 30 depend on claim 28. As it is not clear which features claim 28 refers to it is not possible to search these claims. Claim 32 refers back to claim 32, thus making a meaningful search impossible. Claim 42 refers back to claim 42, thus making a meaningful search impossible. Claim 44 refers back to claim 44, thus making a meaningful search impossible. Claims 45-46 depend on claim 44. As it is not clear which features claim 44 refers to it is not possible to search these claims. Claim 55 refers back to claim 55, thus making a meaningful search impossible. Claims 56-61 depend on claim 55. As it is not clear which features claim 55 refers to it is not possible to search these claims. Claim 63 refers back to claim 63, thus making a meaningful search impossible. Claims 64-66 depend on claim 63. As it is not clear which features claim 63 refers to it is not possible to search these claims.

Claim 53 is not allowable insofar it is related to a radiation therapy; see Rule 39.1(iv) PCT - Method for treatment of the human or animal body by therapy.

In the annex to the international search report the applicant's attention was drawn to the fact that claims, or parts of claims, relating to inventions in respect of which no international search report has been established need not to be the subject of an international preliminary examination (Rule 66.1(e) PCT). The applicant was advised that the EPO policy when acting as an International Preliminary Examination Authority is normally not to carry out a preliminary examination on matter which has not been searched. This is the case irrespective of whether or not the claims are amended following receipt of the search report or during any Chapter II procedure.

Consequently, the statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement will be given only for

those parts of the claims which have been searched and are listed on the cover page.

Re Item IV

Non-unity

The objection as to lack of unity raised in the international search report is maintained. The reasons for the objection are the same as those indicated in the international search report. The follwing inventions have been identified:

Invention 1:
claims 1 (part) - 5 (part), 6, 12 (part) - 19 (part), 21 (part) - 27 (part), 31 (part), 33 (part)- 41 (part), 43 (part)
A solid radiation sensitive device as disclosed in claim 1 comprising a diacetylene as a radiation sensitive material as disclosed in claim 5 and methods and processes using this device.

Invention 2:
claims 1 (part) - 5 (part), 7, 12 (part) - 19 (part), 21 (part) - 27 (part), 31 (part), 33 (part)- 41 (part), 43 (part)
A solid radiation sensitive device as disclosed in claim 1 comprising a radiochromic dye as a radiation sensitive material as disclosed in claim 5 and methods and processes using this device.

Invention 3:
claims 1 (part) - 5 (part), 10, 12 (part) - 19 (part), 21 (part) - 27 (part), 31 (part), 33 (part)- 41 (part), 43 (part)
A solid radiation sensitive device as disclosed in claim 1 comprising a pH sensitive dye as a radiation sensitive material as disclosed in claim 5 and methods and processes using this device.

Invention 4:
claims 1 (part) - 5 (part), 8, 12 (part) - 19 (part), 21 (part) - 27 (part), 31 (part), 33 (part)- 41 (part), 43 (part)
A solid radiation sensitive device as disclosed in claim 1 comprising a leuco dye as a

radiation sensitive material as disclosed in claim 5 and methods and processes using this device.

Invention 5:
claims 1 (part) - 5 (part), 9, 12 (part) - 19 (part), 21 (part) - 27 (part), 31 (part), 33 (part)- 41 (part), 43 (part)
A solid radiation sensitive device as disclosed in claim 1 comprising a carbinol dye as a radiation sensitive material as disclosed in claim 5 and methods and processes using this device.

Invention 6:
claims 1 (part) - 5 (part), 11, 12 (part) - 19 (part), 21 (part) - 27 (part), 31 (part), 33 (part)- 41 (part), 43 (part)
A solid radiation sensitive device as disclosed in claim 1 comprising a radiation sensitive complex as a radiation sensitive material as disclosed in claim 5 and methods and processes using this device.

Invention 7:
claims 47 - 49, 53
A process of irradiation of a device as disclosed in claim 1; a method for monitoring a radiation dose by irradiation of a device of claim 1.

Invention 8:
claim 50
A method of imaging and measuring a three-dimensional dose distribution of a radiation source.

Invention 9:
claim 51
An optical tomographic scanner for imaging optical properties.

Invention 10:

claim 52
A method of detecting, measuring and displaying a non-uniform dose of radiation.

Invention 11:
claim 62 (part)
A solid radiation sensitive device as disclosed in claim 1 wherein said radiation sensitive material is selected from scintillation material.

Invention 12:
claim 62 (part)
A solid radiation sensitive device as disclosed in claim 1 wherein said radiation sensitive material is selected from thermoluminescent material.

The single general inventive concept linking the inventions 1-6, 11, 12 is a solid radiation sensitive device for monitoring radiation dose comprising at least one radiation sensitive material in a polymeric binder as disclosed in claim 1. Document WO9621885 (see page 1, lines 14-26) discloses a radiation sensitive diacetylene in a film device comprising polyethyleneimine as a polymeric binder. The diacetylene undergoes an observable change by polymerizing to form a coloured image when contacted with radiation. Consequently, the subject-matter of claims 1 and 5 is not novel and there is no single general inventive concept linking the inventions 1-6, 11, 12 in the meaning of Rule 13.1 PCT. The separate inventions 1-6, 11, 12 are related to one of the eight radiation sensitive materials as disclosed in claims 5 and 62. The single general inventive concept linking the inventions 1-6, 11, 12 with the inventions 7-10 is a solid radiation sensitive device for monitoring radiation dose comprising at least one radiation sensitive material in a polymeric binder as disclosed in claim 1. However, this general inventive concept is not novel as devices as disclosed in claim 1 are known from document WO9621885 as discussed above.

The applicant paid additional search fees for inventions 2, 4, 6 without protest. Thus, a search has been carried out for the follwing claims insofar as they fall under the scope of inventions 1, 2, 4, 6:

1 (part) - 5 (part), 6, 7, 8, 11, 12 (part) - 19 (part), 21 (part) - 27 (part), 31 (part), 33 (part) - 41 (part), 43 (part)

In the annex to the international search report the applicant's attention was drawn to the fact that claims, or parts of claims, relating to inventions in respect of which no international search report has been established need not to be the subject of an international preliminary examination (Rule 66.1(e) PCT). The applicant was advised that the EPO policy when acting as an International Preliminary Examination Authority is normally not to carry out a preliminary examination on matter which has not been searched. This is the case irrespective of whether or not the claims are amended following receipt of the search report or during any Chapter II procedure.

Consequently, the statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement will be given only for those parts of the claims which have been searched and are listed on the cover page.

Re Item V

Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

Reference is made to the following documents:

D1: WO 96/21885 A (PATEL GORDHANBHAI N ;CHENG YAO MING (US); JP LAB INC (US); PATEL S) 18 July 1996 (1996-07-18)

D2: US-A-5 283 157 (DAVIES PAUL) 1 February 1994 (1994-02-01)

D3: US-A-4 918 317 (HESS TODD M ET AL) 17 April 1990 (1990-04-17)

D4: HSU C-K; AL-SHEIKLY M; MCLAUGHLIN W L; CHRISTOU A: "RADIOCHROMIC THIN-FILM SENSOR USING BLUE TETRAZOLIUM IN POLYVINYL ALCOHOL" MATERIALS RESEARCH SOCIETY SYMPOSIUM PROCEEDINGS, THIN FILMS -STRUCTURE AND MORPHOLOGY, vol. 441, 1997, XP008029266

D5: AL-SHEIKHLY M; MCLAUCHLIN W L; CHRISTOU A; OVACS A: "RADIOCHROMIC BLUE TETRAZOLIUM FILM DOSIMETER" PROCEEDINGS OF THE SYMPOSIUM ON TECHNIQUES FOR HIGH DOSE DOSIMETRY IN INDUSTRY, AGRICULTURE, AND MEDICINE, INTERNATIONAL ATOMIC ENERGY AGENCY, VIENNA, November 1998 (1998-11), pages 59-63,

XP008029270

D6: ABDEL-FATTAH A A ET AL: "Temperature, humidity and time. Combined effects on radiochromic film dosimeters" RADIATION PHYSICS AND CHEMISTRY, ELSEVIER SCIENCE PUBLISHERS BV., AMSTERDAM, NL, vol. 47, no. 4, 1 April 1996 (1996-04-01), pages 611-621, XP004051052 ISSN: 0969-806X

D7: MCLAUGHLIN W L ET AL: "SENSITOMETRY OF THE RESPONSE OF A NEW RADIOCHROMIC FILM DOSIMETER TO GAMMA RADIATION AND ELECTRON BEAMS" NUCLEAR INSTRUMENTS & METHODS IN PHYSICS RESEARCH, SECTION - A: ACCELERATORS, SPECTROMETERS, DETECTORS AND ASSOCIATED EQUIPMENT, NORTH-HOLLAND PUBLISHING COMPANY. AMSTERDAM, NL, vol. A302, no. 1, 1 April 1991 (1991-04-01), pages 165-176, XP000227702 ISSN: 0168-9002

Invention I

The present application does not meet the criteria of Article 33(1) PCT, because the subject-matter of claims 1-6, 12, 17-19, 21-27, 31, 35-40, 43 not novel in the sense of Article 33(2) PCT.

1. Novelty

All citations under 1. and 2. refer to document D1, unless stated otherwise.

1.1. Claims 1, 4, 5
Document D1 (see page 1, lines 14-26) discloses a radiation sensitive diacetylene in a film device comprising polyethyleneimine as a polymeric binder. The diacetylene undergoes an observable change by polymerizing to form a coloured image when contacted with radiation.

1.2. Claim 2
The device may comprise a molded polymer (see example 15, where a dicacetylene dye

crystallizes into an UV active phase from its melt).

1.3. Claim 3
The device has a film shape (see claim 1).

1.4. Claim 6
The diacetylene is selected from derivatives of 2,4-hexadiyn-1 ,6-bis (n-hexylurethane); 2,4-hexadiyn-1, bis (n-pentylurethane); 2,4-hexadiyn-1-mono (n-pentyl-urethane)-6-mono (-hexylurethane); 2,4-hexadiyn-1 -mono (g-hexyl-urethane)-6-mono (phenyl acetate); and co-crystallized mixtures thereof (see claim 3). The diacetylene comprises 2,4-hexadiyn-1,6diol (see example 1, page 10, lines 12-16) and 3,5-octadiyn-1,8diol, [HO(CH2)2-C-C-C~C-(CH2)2OH], 4,6-decadiyn-1 , 1 0-diol, and 5,12-dodecadiyn-1,12-diol (see page 10, lines 12-16). Preferred diacetylenes are the derivatives of 2,4-hexadiyne, 2,4-hexadiyn1,6-diol, 3,5-octadiyn-1 ,8-diol, 4,6-decadiyn-1 1 0-diol, 5,7-dodecadiyn-1 ,1 2-diol and diacetylenic fatty acids, such as tricosa-10,12-diynoic acid (TC), pentacosa-10,12-diynoic acid (PC), and cocrystallized mixtures thereof (see page 9, lines 1-5).

1.5. Claims 12-16, activator (12 not novel, 13-16 not inventive)
The diacetylene can be activated using an organic solvent as an activator (see page 14, lines 23,24). Dichloromethane is used as a solvent (see page 24, line 21).

1.6. Claims 17-19, 21-26, binder
The binder may be polyacrylate, polyethylene oxide, polyethylene imine, polyacrylamide (see page 21, lines 12-14). The binder polymers can be homo-or copolymers (see page 22, lines 5-6). An amine-isocyanate copolymer is used as a binder (see example 1). A vinyl acetate latex is used as a binder (see example 5).

1.7. Claim 27, solvent
The diacetylene can be activated using an organic solvent as an activator (see page 14, lines 23,24).

1.8. Claim 31, converter
The film comprises a converter (see claims 1, 14-20).

1.9. Claims 33, 34, 35 (33,34 not inventive, 35 not novel)
The radiation sensitve layer is 1 to 50 micorons thick; the thickness of the substrate is 10 to 300 microns thick (see page 8, lines 4-9). Thus, the device can be more than 300 microns thick, which is more than 0.3 millimeter.

1.10. Claim 36
(see claim 41: mixture of higher acetylenes (=oligomer); split di acetylenes (=monomer); polymeric di and higher acetylenes (=polymer);) at least a radiation sensitive material (see claim 35). The diacetylene can be activated using an organic solvent as an activator (see page 14, lines 23,24). A plasticizer can be also present (see page 7, line 12).

1.11. Claim 37
The film is transparent (see claim 61).

1.12. Claim 38
The film undergoes a colour change under irradiation (see claims 1,2).

1.13. Claim 39
The film contains an UV absorber (see page 7, line 20).

1.14. Claim 40
The film contains a surfactant (see page 6, line 15).

1.15. Claims 41, 43
A film of polymerized diacetylenes is melted and solidified; the material is radiation sensitive (see example 16).

2. Inventive step

The subject-matter of claims 13-16, 33 and 34 does not involve an inventive step (Article 33(3) PCT) for the following reasons.

2.1. Claims 12-16, activator (12 not novel, 13-16 not inventive)
The diacetylene can be activated using an organic solvent as an activator (see page 14, lines 23,24). Dichloromethane is used as a solvent (see page 24, line 21).

The subject-matter of claims 13 and 15 differs from the state of the art by using a halocarbon in general (claim 13) or a specific halocarbon (claim 15) as an activator.

There is no technical effect related to this difference. The remaining problem to be solved is to provide an alternative composition. However, all the halocarbons mentioned in claim 15 are known to be used as solvents. Thus, the subject-matter of claims 13 and 15 is not inventive.

The subject-matter of claims 14 and 16 differs from the state of the art by using a halonium or sulfonium compound in general (claim 14) or a specific halonium or sulfonium compound (claim 16) as an activator.

There is no technical effect related to this difference. The remaining problem to be solved is to provide an alternative composition. However, it is known to use iodine compounds as activators in imaging processes (see document D2, claims).

Thus, the skilled person, starting from D1 and looking for alternatives would try out other iodine compounds as an alternative activators; the subject-matter of claims 14 and 16 is not inventive.

2.2. Claims 33, 34

The subject-matter of claims 33 and 34 differs from the subject-matter of D1 (claim 1) in that the film is self-supporting whereas in D1 the film is produced on a substrate.

However, there is no technical effect related to this difference. As it is known that films as disclosed in D1 can be melted and resolidified (see example 16 and tables 1, 2) it is obvious from D1 that one could produce a radiation sensitive film without a substrate as well.

Hence, the subject-matter of claims 33, 34 does not involve an inventive step.

Inventions 2, 4, and 6:

3. Novelty

Document D3 discloses microencapsulated dyes in a radiochromic device: pararosaniline cyanide; hexa(hydroxyethyl) pararosaniline cyanide; new fuchsin cyanide; crystal violet cyanied; malachite green cyanide; brilliant blue cyanide; methyl green cyanide; helvetia green cyanide; binders are geatin, polyvinyl alcohol, polyacrylamide; acrylic latices; UV absorbers are used; as activators 2-Imidazoline and citric acid are used; the microcapsules may be melamine-formaldehyde or urea-formaldehyde.

Document D4 discloses a radiation sensitive device comprising blue tetrazolium in a polyvinylacetate film.

Document D5 discloses a radiation sensitive device comprising blue tetrazolium in a polyvinylacetate film.

Document D6 discloses radiation sensitive devices comprising the leuconitrile of hexa (hydroxy) pararoaniline in a nylon film and the leuconitrile of pararosaniline in a polyvinyl butyral film. Document D7 discloses radiation sensitive devices comprising a hexa hydroxyethyl pararoaniline in a nylon film.

Thus, the subject-matter of claims 1-5,7,8,12,17-27,33,34,37-39, 41, 43 is not novel (Article 33(2) PCT).

4. Inventive step (Article 33(2) PCT)

There are no additional features in inventions II, IV and VI that might form a basis for the presence of an inventive step with the exception of claim 11 (invention 6):

Ammonium iron citrate as a radiation sensitive material is novel and there is no indication in the prior art that might lead the skilled person to use such a material.

In the absence of a technical effect the use of ammonium iron citrate might be inventive because it is a non-obvious alternative.

We claim:

1. A solid radiation sensitive device for monitoring radiation dose comprising at least one radiation sensitive material in a polymeric binder wherein said radiation sensitive material is capable of undergoing an observable change when contacted with radiation.

2. The solid radiation sensitive device of claim 1 wherein said device comprises a molded polymer or casted polymer.

3. The solid radiation sensitive device of claim 2 wherein said device has a shape selected from coating, film, fiber, rod, plaque, block, regular shape or irregular shape.

4. The solid radiation sensitive device of claim 1 wherein said radiation is selected from UV, X-ray, gamma-ray, electrons, protons, alpha particles or neutron radiation.

5. The solid radiation sensitive device of claim 1, wherein said radiation sensitive material comprises at least one material selected from a diacetylene; a radiochromic dye; a pH sensitive dye; a leuco dye; a carbinol dye and a radiation sensitive complex.

6. The solid radiation sensitive device of claim 5 wherein said diacetylene comprises at least one compound selected from 2,4-hexadiyn-1,6-diol, 3,5-octadiyn-1,8-diol, 4,6-decadiyn-1,10-diol, 5,7-dodecadiyn-1,12-diol, tricosa-10,12-diynoic acid, pentacosa-10,12-diynoic acid, their derivatives, including 2,4-hexadiyn-1,6-bis (n-Hexylurethane); 2,4-hexadiyn-1,6-bis (n-pentylurethane); 2,4-hexadiyn-1-mono (n-pentyl-urethane)-6-mono (n-hexylurethane); 2,4-hexadiyn-1-mono (n-hexyl-urethane)-6-mono (phenyl acetate); 5,7-dodecadiyn-1,12-bis(n-butoxycarbonyl methylurethane) and co-crystallized mixtures thereof.

7. The solid radiation sensitive device of claim 5 wherein said radiochromic dye is selected from fuschin cyanide, hexahydroxy ethyl violet cyanide, pararose aniline cyanide, a tetrazolium dye including blue tetrazolium, tetrazolium violet, triphenyl tetrazolium chloride or mixture thereof.

8. The solid radiation sensitive device of claim 5 wherein said leuco dye is selected from leuco crystal violet, leuco malachite green or mixture thereof.

9. The solid radiation sensitive device of claim 5 wherein said carbinol dye is selected from malachite green carbinol base and p-roseaniline base.

10. The solid radiation sensitive device of claim 5 wherein said pH sensitive dye is selected from pentamethoxytriphenylmethanol, bromocresol purple, bromophenol blue or mixture thereof.

11. The solid radiation sensitive device of claim 1 wherein said radiation sensitive material is a complex of ammonium iron citrate.

12. The solid radiation sensitive device of claim 1 further comprising an activator.

13. The solid radiation sensitive device of claim 12 wherein said activator is a halocarbon.

14. The solid radiation sensitive device of claim 12 wherein said activator is a halonium or sulfonium compound.

15. The solid radiation sensitive device of claim 13 wherein said halocarbon is selected from ethyl trichloroacetate, heptachloropropane, ethyltrichloroacetate, chloroacetic acid, chloropropionic acid, hexachlorocyclohexane, methyltrichloroacetimidate, trichloroacetic acid, trichloroacetamide, trichloro ethanol, trichloro methyl benzyl acetate, trichloro methyl propanol hydrate, trichloro propane, chlorinated polymers and oligimers or mixture thereof.

16. The solid radiation sensitive device of claim 14 wherein said activator is selected from diphenyliodinium iodide, diphenyliodinium hexafluoroarsenate, diphenyliodinium chloride, trimethylsulfonium iodide, triphenylsulfonium hexafluoroantimonate or mixture thereof.

17. The solid radiation sensitive device of claim 1 wherein said binder is a polymerized monomer or oligomer.

18. The solid radiation sensitive device of claim 1 wherein said binder is a polymerized di or polyfunctional monomer or oligomer.

19. The solid radiation sensitive device of claim 1 wherein said binder is a polymer prepared by polymerization of a monomer or oligomer by radical or cationic polymerization process using initiator.

20. The solid radiation sensitive device of claim 20 wherein said monomer and oligomers is olefins, vinyls, acrylates, methylmethacrylate, styrene and acrylic acid, or oligomeric methylmethacrylate, methylacrylate or polypropylenedimethacrylate.

21. The solid radiation sensitive device of claim 1 wherein said binder is a polymer prepared by initiating polymerization with UV and visible light.

22. The solid radiation sensitive device of claim 1 wherein said binder a reaction product of two monomers.

23. The solid radiation sensitive device of claim 1 wherein said binder is a reaction product of one of diol with diisocyanate, diepoxide with primary amine, primary diamine or secondary diamine, or a diamine with a diisocyanate.

24. The solid radiation sensitive device of claim 17 wherein said monomer is selected from hexamethylene diisocyanate, polyethylene glycol, polypropylene glycol.

25. The solid radiation sensitive device of claim 1 wherein said binder is obtained by cooling a molten homopolymer, copolymer or graft copolymer.

26. The solid radiation sensitive device of claim 1 wherein said binder comprises at least one of polyvinylacetate, polyethylene, polyethylene-co-polyacrylic acid, polystyrene, polymethylmethacrylate, polysilicones, polybutadiene, polyvinyl chloride, poly vinylidene chloride and polyepichlorohydrin.

27. The solid radiation sensitive device of claim 1 further comprising a solvent.

28. The solid radiation sensitive device of claim 28 wherein said solvent is a solvent for a radiation sensitive material.

29. The solid radiation sensitive device of claim 28 wherein said solvent is a plasticizer for said binder.

30. The solid radiation sensitive device of claim 28 wherein said solvent is chosen from butoxy-2-ethylstearate, butyrolactone, diethyl fumarate, dimethyl maleate, dimethylcarbonate, dioctyl phthalate, ethylene glycol dimethyl ether, ethyl salicylate, polyethylene glycol dimethylether, propylene carbonate, triacetin, benzyl ether, dodecyl-1,2-methyl pyrrolidone, ethoxyethylacetate, ethylene glycol diacetate, ethyltrichloroacetate, methylpyrrolidone, methyl sulfoxide, polyethylene glycols of different molecular weight, dimethylformamide, cyclohexane, p-dioxane, tetrahydrofuran, p-xylene and dioctylphthalate or dibutylphthalate.

31. The solid radiation sensitive device of claim 1 further comprising a converter.

32. The solid radiation sensitive device of claim 32 a wherein said converter is a radio/electron luminescence or fluorescence phosphor which emits UV light, or lower energy X-ray or electrons when contacted with high energy X-rays, gamma rays, or electrons.

33. The solid radiation sensitive device of claim 1 wherein said device is self-supporting.

34. The solid radiation sensitive device of claim 1 wherein said device is a self-supporting film, fiber, plaque, rod or block.

35. The solid radiation sensitive device of claim 1 wherein said device has a thickness larger than 0.1 millimeter.

36. The solid radiation sensitive device of claim 1 further comprising a mixture of monomer, oligomer, polymer, radiation sensitive material, activator, solvent and plasticizer.

37. The solid radiation sensitive device of claim 1 wherein said device is transparent.

38. The solid radiation sensitive device of claim 1 wherein said observable change is selected from color change, change in fluorescence, phosphorescence, change in paramagnetic or NMR relaxation rate, when exposed to said radiation, liquid to solid, solid to liquid, or change in transparency.

39. The solid radiation sensitive device of claim 1 further comprising a UV absorber.

40. The solid radiation sensitive device of claim 1 further comprising a surfactant.

41. A process of making radiation sensitive molded or casted shaped polymeric device for monitoring radiation dose prepared by polymerization of at least one monomer or oligomer containing at least one radiation sensitive material capable of developing or undergoing a color, fluorescence, or opacity change when exposed to UV, X-ray, gamma ray, electron, protons, alpha particles or neutron radiation activator.

42. The process of claim 42 wherein said device further comprises at least one of a UV absorber, a convertor, a surfactant and a solvent.

43. A process of making radiation sensitive molded or casted shaped polymeric device for monitoring radiation dose prepared by solidification of molten polymer containing at least one radiation sensitive material capable of developing or undergoing a color, fluorescence, or opacity change when exposed to radiation.

44. The process of claim 44 wherein said device has a shape selected from coating, film, fiber, rod, plaque, block, regular shape or irregular shape.

45. The process of claim 44 wherein said radiation is selected from UV, X-ray, gamma-ray, electrons, protons, alpha particles or neutron radiation.

46. The process of claim 44 wherein said device further comprises at least one of an activator, a UV absorber, a convertor, a surfactant and a solvent.

47. A process of irradiation of a device of claim 1 with UV, X-ray, gamma ray, electron, protons, alpha particles or neutron radiation thereby producing said observable change in said device.

48. A method for monitoring high energy comprising the step of placing the device of claim 1 in the path of UV, X-ray, gamma ray, electron, protons, alpha particles or neutron radiation and monitoring radiation dose by monitoring said observable change caused by the said radiation.

49. A process of monitoring dose in three dimensions comprising steps of irradiation of the device of claim 1 and scanning said device.

50. A method of imaging and measuring a three-dimensional dose distribution of a radiation source in the device of claim 1 comprising the steps of irradiating said device such that the optical properties are changed upon irradiation, optically scanning the object at various angles, detecting and measuring light projection data indicative of optical changes in the device, calibrating the optical change in the device to the dose of the energy; and mapping the dose of the energy in the object.

51. An optical tomographic scanner for imaging optical properties of device of claim 1 comprising at least one light source for illuminating the device, at least one light detector for measuring light that has interacted with the object, a mechanism that controls the relative motion of the object, the light source or sources, and the light detector or detectors, a tank filled with a liquid in which the object is immersed for refractive index matching, so that the light rays passing through the device are propagated in straight lines; and a computer for controlling the scanner mechanism and for calculating the three dimensional distribution of optical properties inside the object.

52. A method of detecting, measuring and displaying a non-uniform dose of radiation or by forming a visible permanent three dimensional image in said device of claim 1 wherein said three dimensional image is representative of the three dimensional distribution of dose of said radiation to which said device is exposed.

53. Monitoring dose, radiation therapy, sterilization medical supplies or perishables with a device of claim 1.

54. The solid radiation sensitive device of claim 1 wherein said binder comprises a gel.

55. The solid radiation sensitive device of claim 55 further comprising water.

56. The solid radiation sensitive device of claim 55 further comprising an organic liquid.

57. The solid radiation sensitive device of claim 55 further comprising a mineral oil or paraffin.

58. The solid radiation sensitive device of claim 55 wherein said binder comprises a water soluble or water swellable polymer.

59. The solid radiation sensitive device of claim 55 wherein said binder is soluble or swellable in organic solvents.

60. The solid radiation sensitive device of claim 55 comprising no solvent .

61. The solid radiation sensitive device of claim 55 wherein said binder comprises a silicone or olefinic polymer.

62. The solid radiation sensitive device of claim 1 wherein said radiation sensitive material is selected from scintillation material and thermoluminescent material.

63. The solid radiation sensitive device of claim 63 wherein said scintillation material comprises one of an organic solid, an inorganic crystal or a gas.

64. The solid radiation sensitive device of claim 64 wheiren said organic solid is selected from anthracene, trans-stilbene and naphthalene.

65. The solid radiation sensitive device of claim 64 wherein said inorganic crystal is selected from Tl activated sodium, Tl activated CsI and BaF_2.

66. The solid radiation sensitive device of claim 64 wherein said gas comprises at least one gas selected from Xe, Kr, Ar, He or Ne.